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PATENT TRADEMARK OFFICE

Docket No: 9613/OL088

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Masaaki Takagi; Toshio Sadamitsu; Katumi Saitou

Serial No.: 09/905,000

Art Unit: 2834

Confirmation No.: 3447

Filed: 07/13/2001

Examiner: Heba Elkassabgi

For: CLAW POLE PERMANENT MAGNET STEPPING MOTOR

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PENDING CLAIMS

Hon. Commissioner of  
Patents and Trademarks  
Washington, DC 20231

February 4, 2003

Sir:

1. (Amended) A claw-pole permanent magnet stepping motor, comprising:

a first case unit having a length wherein said first case unit is continuous along its length;

a second case having a length wherein said second case unit is continuous along its length;

said first and said second case units having a total length;

a rotor having at least a first and a second permanent magnet;

said first and said second case units having a shape supporting said rotor;

a third and a fourth arcuate section on each said first and said second case units;

a fifth and a sixth side wall section joining each respective said third and forth arcuate sections in a continuous flattened-oval section about said rotor;

said third and said forth arcuate sections each having a first diameter; and

a ratio of said total length to said first diameter is at least 1:1, whereby said claw-pole permanent magnet stepping motor has a reduced size, eliminates magnetic circuit obstructions, and prevents external flux leakage to allow use with magnetic devices while providing an adequate rotational torque.

2. A claw-pole permanent magnet stepping motor, according to claim 1, wherein:

said ratio is preferably 2:1 whereby said claw-pole permanent magnet stepping motor has a reduced size while providing adequate rotational torque despite said ratio.

3. A claw-pole permanent magnet stepping motor, according to claim 1,

wherein:

said third and said fourth arcuate sections each have a first thickness;  
said fifth and said sixth wall sections each have a second thickness; and  
said first thickness being greater than said second thickness, whereby size is reduced, magnetic circuit obstructions are eliminated, and external flux leakage is minimized.

4. (Amended) A claw-pole permanent magnet stepping motor, according to claim 3, wherein:

said fifth and said sixth wall sections each having a planar shape and being closer to said rotor than said third and said fourth arcuate sections; and

said at least first case unit having a flattened-oval cross section, whereby said claw-pole permanent magnet stepping motor has a reduced size.

5. A claw-pole permanent magnet stepping motor according to claim 4, further comprising:

a first thin wall section on each said fifth and said sixth sections orthogonal each said third and said fourth arcuate sections;

said first thin wall section having a third thickness; and

said third thickness being less than said second thickness, whereby said claw-pole permanent magnet stepping motor may be made with an increased torque while retaining a same external size.

6. (Amended) A claw-pole permanent magnet stepping motor according to claim 2, further comprising:

- a first metal bearing in said first case unit;
- a second metal bearing in said second case unit;
- said rotor supported between said first and said second metal bearings;
- a plurality of magnetic poles on said first and second permanent magnets;
- a first and a second phase inductor in each respective said first and said second unit case opposite each respective said first and second permanent magnets;
- said first and said second phase inductors disposed symmetrically in each respective said first and said second case units; and
- said first and said second phase inductors each formed from at least a first and a second magnetic plate each including multiple claw-poles and a first and a second coil each with a set of connectors, whereby said adequate rotational torque is created.

7. (Amended) A claw-pole permanent magnet stepping motor, comprising:

- a first case unit having a length wherein said first case unit is continuous along its length;
- a second case having a length wherein said second case unit is continuous along its length;

a first and a second case unit having a total length wherein a material forming said first and second case units is magnetic;

a rotor having at least a first and a second permanent magnet;

said first and said second case units having an oval shape supporting said rotor;

a third and a fourth arcuate section on each said first and said second case units;

a fifth and a sixth side wall section joining each respective said third and forth arcuate sections in a continuous flattened-oval shape about said rotor;

said third and said forth arcuate sections each having a first diameter;

said total length and said first diameter having a ratio of at least 1:1;

said third and said fourth arcuate sections each have a first thickness;

said fifth and said sixth wall sections each have a second thickness;

said first thickness being greater than said second thickness;

said fifth and said sixth sections each having a planar shape and being closer to said rotor than said third and said fourth arcuate sections;

said at least first case unit having a flattened-oval cross section, whereby said claw-pole permanent magnet stepping motor has a reduced size, eliminates magnetic circuit obstructions, and prevents external flux leakage to allow use with magnetic devices while providing an adequate rotational torque;

a first metal bearing in said first case unit;

a second metal bearing in said second case unit;  
said rotor supported between said first and said second metal bearings;  
a plurality of magnetic poles on said first and second permanent magnets;  
a first and a second phase inductor in each respective said first and said second unit case opposite each respective said first and second permanent magnet;  
said first and said second phase inductors disposed symmetrically in each respective said first and said case units; and  
said first and said second phase inductors each formed from at least a first and a second magnetic plate each having multiple claw-poles and a first and a second coil each with a set of connectors, whereby said adequate rotational torque is created.

8. A claw-pole permanent magnet stepping motor, according to claim 7, wherein:

said ratio is preferably 2:1.

9. (Amended) A claw-pole permanent magnet stepping motor, comprising:

a first case unit having a length wherein said first case unit is continuous along its length;

a second case having a length wherein said second case unit is continuous along its length;

said first case unit and said second case unit having a first total length wherein a

material forming said first and second case units is magnetic;

a rotor including a first and a second permanent magnet;

said first and said second case units having a oval shape supporting said rotor;

a permanent magnet magnetized to form a plurality of poles;

said permanent magnet on said rotor;

a first phase inductor;

a second phase inductor;

said first and said second phase inductors disposed symmetrically in each respective said case unit;

said first and said second phase inductors each including at least a plurality of claw poles and a coil;

said first and said second case units having a first diameter; and

a ratio of said first total length to said first diameter is at least 1:1, whereby said claw-pole permanent magnet stepping motor has a reduced size, eliminates magnetic circuit obstructions, and prevents external flux leakage to allow use with magnetic devices while providing an adequate rotational torque.

10. A claw-pole permanent magnet stepping motor, according to claim 9, wherein:

said ratio is preferably 2:1, whereby said adequate rotational torque is maintained.

11. A claw-pole permanent magnet stepping motor, according to claim 10, further comprising:

a securing section detachably attached to an outside side surface of at least one of said first and said second case unit;

a securing section containing an externally threaded section; and

said securing section being detachably fixable to an external attachment base for said claw-pole permanent magnet stepping motor, whereby said claw-pole permanent magnet stepping motor may be easily affixed to an external device.

12. (Amended) A claw-pole permanent magnet stepping motor, according to claim 11 wherein:

each said first and said second phase inductor includes said coil and a magnetic plate formed integrally from a magnetic material;

each said magnetic plate having an oval shape, including a flat oval-shaped section and an extending plurality of claw-poles, for sliding insertion in each respective said first and said second case unit, whereby assembly time is reduced and efficiency increased.

13. A claw-pole permanent magnet stepping motor, according to claim 12, wherein:

each said coil includes a coil bobbin; an insulated copper wire wrapped around said coil bobbin, and a connector;



said coil bobbin including a first and a second collar;

said connector disposed at at least one of said first and said second collar orthogonal to said coil; and

said coil bobbin having a flat oval shape with arcuate sections, whereby said coils are quickly install-able inside each respective said first and said second case units.